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Research Article

TOXICITY OF NICKEL TO FRESH WATER FISH, *CHANNA GACHUA* (HAM.)

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ABSTRACT
Heavy metals are considered as the most important pollutants of the aquatic environment. In the present study, acute toxicity test was used for the determination of lethal toxicity of Nickel in adult fish, *Channa gachua* as the test organism. Toxicity test is most reliable for accessing the adverse effect of pollutants on aquatic life. The LC_{50} values were determined and observed that the values decreased with increase in the exposure period of the fish. The present investigation revealed that the mortality of test fish were dose and time dependent and might be due to bio concentration of these metals in tissues due to continuous exposure leading to the death of the fish.

Keywords: *Nickel, Acute Toxicity, LC_{50}, Channa gachua*

INTRODUCTION
Pollution of aquatic ecosystem is recognized as a potential threat to aquatic organisms. Water resources are polluted due to discharge of effluents from various industries, agricultural run-off having insecticides, pesticides, heavy metals, fertilizers, chemicals, sewage and other domestic wastes (Woodlings *et al.*, 2001). Among the various pollutants, heavy metals have been recognized as strong poisons and have a cumulative action (Virk and Kaur, 1999).
Contamination of freshwater with heavy metals has become a matter of great concern due to the damage caused to aquatic life especially fishes (McGeer *et al.*, 2000).
Heavy metals are non-bio degradable and once discharged into the water bodies accumulate in the aquatic organisms, including fish causing an adverse effect on them (Ptashynshi *et al.*, 2001; Waqar, 2006). Fish are widely used to evaluate the health of aquatic ecosystem as the physiological changes can serve as biomarkers of environmental pollution (Saravanan *et al.*, 2003). The effects of different pollutants on the aquatic organisms have been studied by many workers.
Alteration in the biochemical pathways induced by Cadmium was reported by Bhattacharyya *et al.*, (2000). Rao *et al.*, (2003), reported that chloropyrifos reduces the oxygen consumption in fish *Oreochromis mossambicus*. Hansen *et al.*, (2002) reported mortality and alterations in growth of rainbow trout on exposure to Copper.
Among heavy metals Nickel is black listed by the European community. It is nonessential and highly toxic which is distributed and released in the aquatic environment by industrial sources such as Ni-Cd batteries, plating processes, refining of ores, etc. Effluents from such industries are sources of Nickel in aquatic environment.
Nickel does not breakdown in the environment and can bio accumulate for many years after exposure to low levels of this metal. Nickel has been considered as an important xenobiotic, persistent and non bio degradable chemical pollutant in the aquatic environment (Mance, 1987).
Toxicity testing is an essential tool for accessing the action and fate of toxicants in aquatic ecosystems. It is also necessary to derive the water quality standards for chemicals and to identify suitable organisms as bio indicators.
The toxicity tests help to access various abnormalities caused due to administration of a chemical or pollutant and to determine the order of lethality of the chemical (Absunullah *et al.*, 1981). Toxicity in fish is a result of a series of events involving various physical, chemical and biological processes.
Estimation of median lethal concentration or dosage (LC_{50} or LD_{50}) is valuable as it can be used as an indicator to the level of resistance of population response to metals (Reda *et al.*, 2010).

Thus, toxicity study in fishes is the best suitable method to check the pollution in water bodies (Suedel *et al.*, 1997). It is an important tool in eco toxicology and act as a diagnostic endpoint for screening, differentiating the effluents and their effects on aquatic organisms.

MATERIALS AND METHODS

Adult and live *Channa gachua* were collected from the local market and brought to laboratory. Only healthy fishes (Length: 12-15 cm, Weight: 50-56 g) were taken for experiment. Fishes were acclimatized in glass aquaria for 15 days and were fed with fish food (earthworms) and water in the aquaria was replaced by freshwater at every 24 hrs.

Stock solution of Nickel Sulphate ($NiSO_4$) was prepared by dissolving appropriate amount of $NiSO_4$ as Ni salt in distilled water. Fishes were exposed to various concentrations of Nickel for 24, 48, 72 and 96 hrs. Simultaneously, the control group was also maintained. The data collected were plotted statistically into regression lines (mortality in probit/concentration i.e., probit kill/concentration) according to the methods of Finney (1971) which allows the calculation of average lethal concentration (LC_{50}) for 24, 48 72 and 96 hrs.

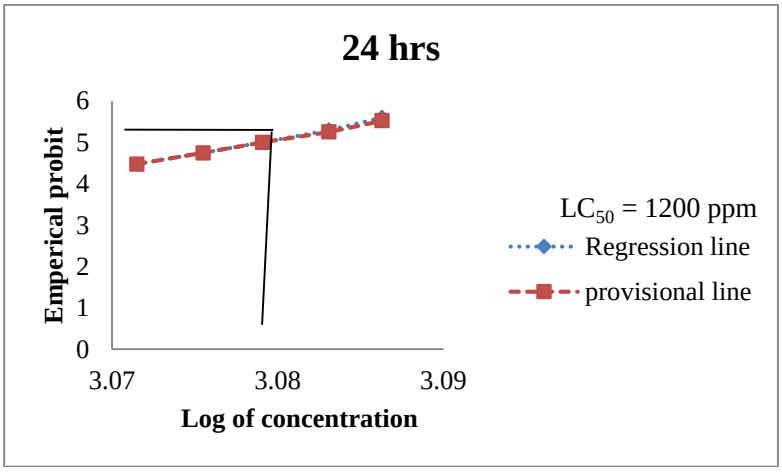
RESULTS AND DISCUSSION

Results

Fishes were exposed to lethal concentration of Nickel for a short term exposure. The LC_{50} values of Nickel under normal laboratory conditions to *Channa gachua* were found at 1200 ppm, 600 ppm, 300 ppm, 150 ppm for 24, 48, 72 and 96 hrs respectively. Regression analysis for 24, 48, 72 and 96 hrs have also been calculated. (Table 1) (Graph 1: 1A, 1B, 1C, 1D). It is clearly evident that there exists an inverse relationship between exposure duration and concentration of Nickel.

Table 1: LC_{50} Values for Heavy Metal Nickel (Ni) as $NiSO_4$, for a Period of 24, 48, 72 and 96 hrs in Freshwater Fish, *Channa Gachua*

Exposure Period in Hrs.	LC_{50} Values (ppm)	Regression Equation Y = y + b (x – x)	Variance
24	1200	Y = 69.4666 X – 208.8932	6.95×10^{-7}
48	600	Y = 36.9296 X - 97.6150	0.0000249
72	300	Y = 17.7722 X – 38.9801	0.000104
96	150	Y = 7.3779 X – 11.0345	0.000622



1(A)

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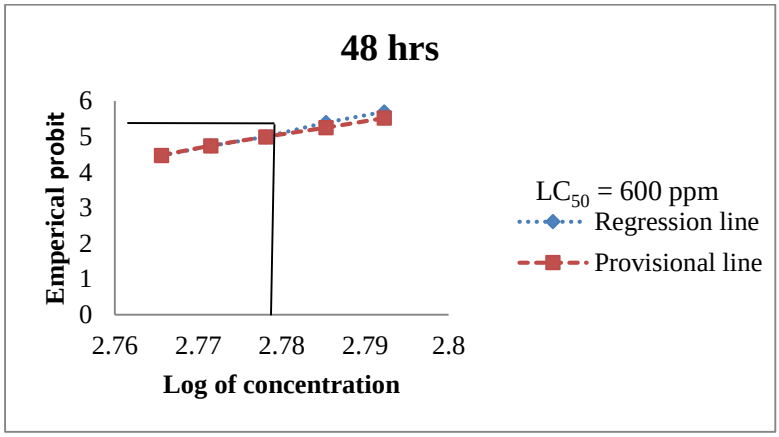

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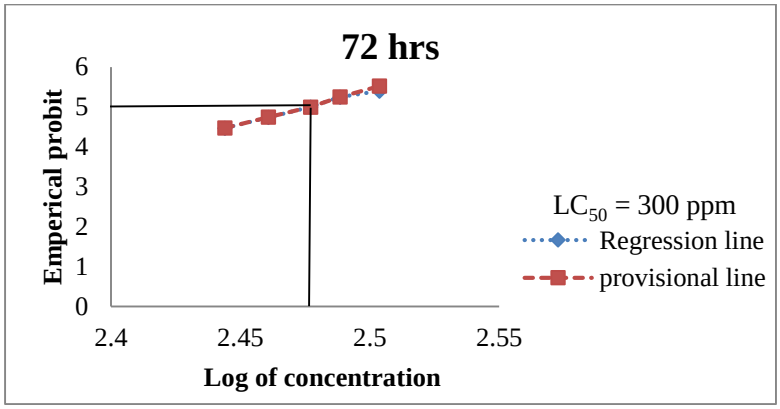

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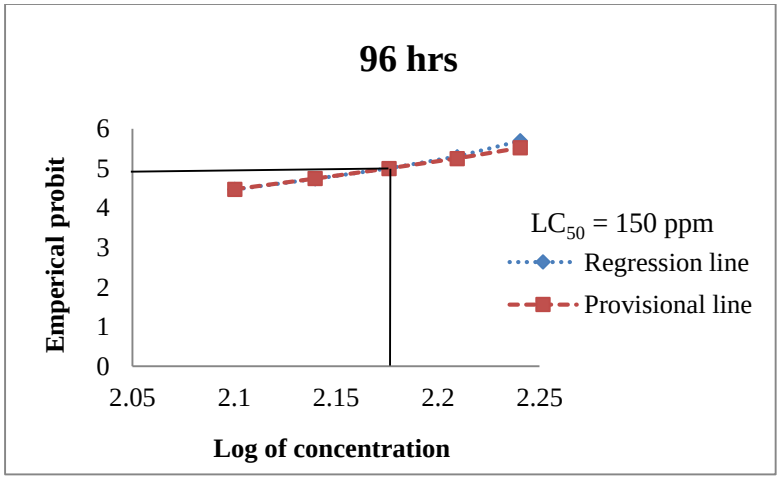

1(D)

Graph 1: Average Probit Analysis of Heavy Metal Nickel (Ni) as $NiSO_4$ on Exposure to Freshwater Fish, *Channa Gachua* for a Period of 24, 48, 72 and 96 hrs [1(A), 1(B), 1(C) and 1(D) Respectively]

Discussion

Pollution of aquatic environment with heavy metals is a worldwide problem due to persistency and continuous accumulation of metals in the environment. An increase in industrialization and urbanization

has led to a drastic increase in the environmental contamination. Aquatic organisms are exposed to high levels of these heavy metals.

Fishes are highly sensitive to changes in their surrounding environment. Heavy metals pose serious environmental problems as they are major constituents of the industrial effluents. Assessing the acute toxicity of heavy metals to fish will help to design environmental monitoring strategies and ecosystem conservation measures (Agarwal, 1991).

Results indicate that NiSO4 poses toxic effect on fish *Channa gachua* which is evident by the findings of present investigations and LC_{50} values. The fish mortality may have resulted by absorption, bioaccumulation of NiSO4 or greater activity of chemical on the fish body.

Toxicological studies of the pollutants upon aquatic organisms are very important from the view point of environmental consequences. Fishes are often forced to encounter highly contaminated waters especially in areas where dilution rate of waste waters is low.

Estimation of LC_{50} of heavy metals is important with reference to a particular fish species (Maruthanayagam *et al.*, 2002). According to Brongs and Mount (1987), the application of the LC_{50} value is the most highly reliable test for accessing the adverse effects of a chemical contaminant to aquatic life. In the present study, acute toxicity of Nickel on the test fish, *Channa punctatus* has been analyzed and behavioral responses were also recorded.

In the present study acute toxicity test was used for the determination of lethal toxicity of Nickel using an adult *Channa gachua* as test organism. This metal is relatively toxic and affect the survival of fishes and other aquatic organisms (James, 1990). Mortality of aquatic animals is the most significant parameter in toxicology (Vinodini and Narayanan, 2008). The toxicity tests and applications of LC_{50} values have gained acceptance among toxicologists (Brungs and Mount, 1987).

The median lethal concentrations for Nickel at various intervals is summarized in table 1 and figure 1A, 1B, 1C and 1D, revealed that the mortality rate of *Channa gachua* was concentration and time dependant. Also the mortality of the fish exposed to the metal increases with increasing exposure duration. The LC_{50} values decreased with increase in exposure time in test fish. From the present study it is clear that an increase in the concentration of the metal require an exposure time to bring about 50% mortality of fish. Further it is also clear that the mortality of the test fish were dose and time dependent and shows regular mode of action which might be due to magnification of these metals in tissues upto a dangerous level thereby leading to the death of the test fish (Karuppasamy, 2004). According to Mohammed *et al.,* (2012) a rise in the mortality rate of fish with increasing concentration reveals bio-concentration of heavy metal under continuous exposure.

Thus, acute toxicity studies can help to detect and evaluate the degree of pollution by providing reliable estimates of safe concentration from which water quality criteria can be derived. These dose response studies in animals are used to set standards for human exposure and the amount of chemical residue that is allowed in the environment. Thus environmental protection is the major requirement of the society.

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